

A lectotype for *Deuterammina (Deuterammina) rotaliformis* (Heron-Allen & Earland) and new trochamminids from E. Ireland (Protozoa: Foraminiferida)

P. Brönnimann

Laboratoire de Paléontologie, Université de Genève, 13, rue des Maraîchers, 1211 Genève 4, Switzerland

J. E. Whittaker

Department of Palaeontology, British Museum (Natural History), Cromwell Road, London SW7 5BD

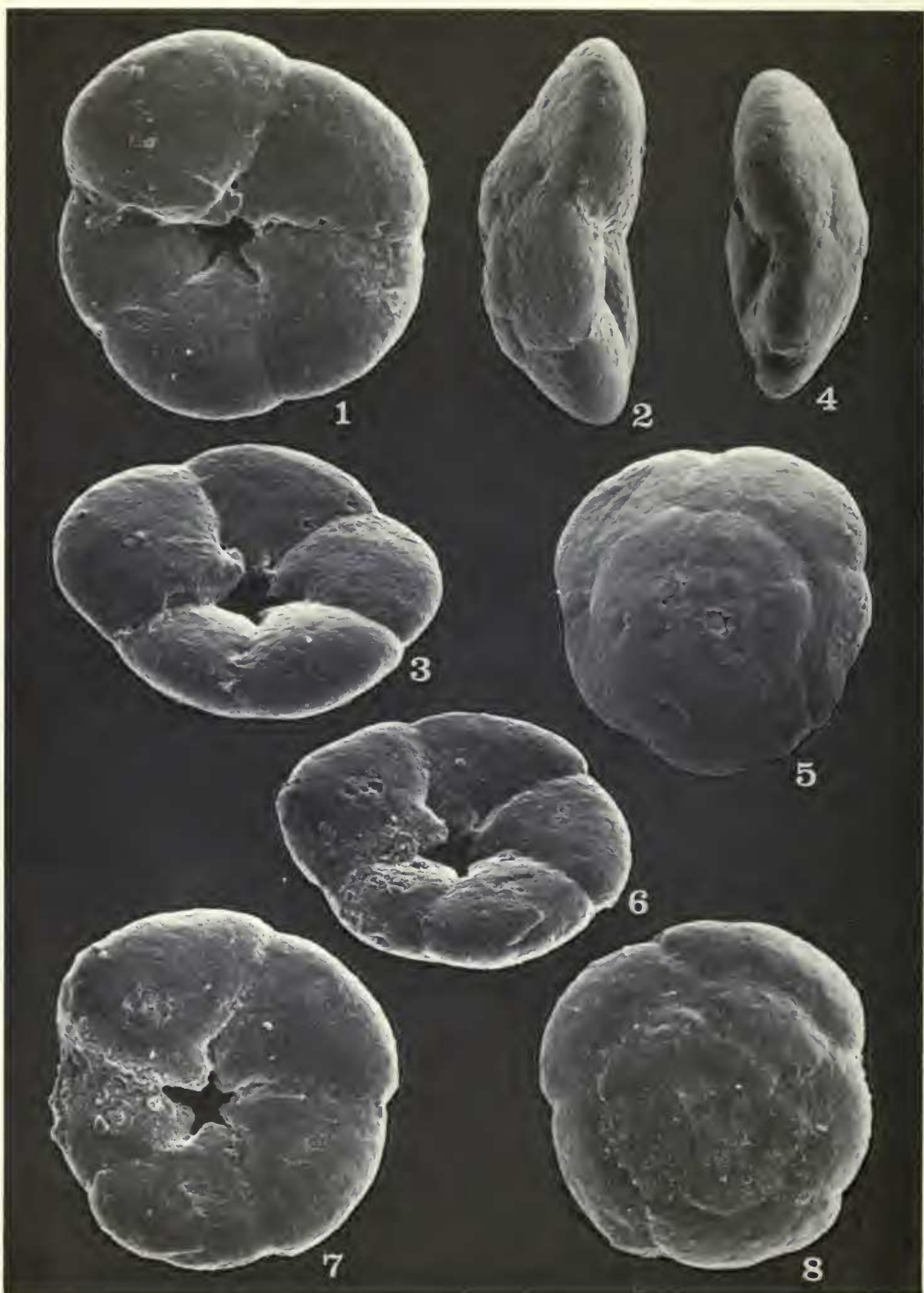
Introduction

In their 'Report on some Recent Foraminifera found off the coast of Dublin and in the Irish Sea', Balkwill & Wright (1885) illustrated four views, two umbilical and two spiral (pl. 13, figs 11a, b and 12a, b) of agglutinating foraminifera which they refer to as '*Trochammina inflata* Montagu sp. var.'; no formal description was given. Twenty-six years later Heron-Allen & Earland (1911 : 309) encountering in shore sands of Selsey Bill, Sussex, a single trochamminid which they regarded as identical with that reported by Balkwill & Wright, sent it to Joseph Wright in Ireland for a second opinion. Wright indeed agreed with their identification. In their paper, Heron-Allen and Earland cite it as '*Trochammina rotaliformis* J. Wright MS' and write '... as Mr. Wright will, we understand, describe and figure the variety shortly under the name *rotaliformis*, we refrain from further particulars of the variety which has not hitherto been accorded a distinctive name, although presenting well-marked characteristics'. Wright did not publish this description, but Heron-Allen & Earland by referring to Balkwill & Wright's figures, while citing Wright's manuscript name, themselves made the name available. Article 12 of the International Code of Zoological Nomenclature states 'that names published before 1931 ... must have been accompanied by a description, definition or indication [Art. 16]'; an indication being constituted under Article 16a (i) by 'a bibliographic reference to a previously published description, definition or figure'. An 'indication' was therefore clearly given, furthermore, Heron-Allen and Earland are the authors of the name, not Wright, with 1911 being the date of availability (R. V. Melville, pers. comm.). This is contrary to subsequent references to the species as '*Trochammina rotaliformis* J. Wright MS' by Heron-Allen & Earland (1913), Cushman (1920), and in the Catalogue of Foraminifera (Ellis & Messina, 1940 *et seqq.*).

Cushman (1920 : 77, pl. 16, figs 1, 2) re-illustrated Balkwill & Wright's four figures, and at the same time made the first formal description of the species. . .

Test small, trochoid, spire somewhat elevated, composed of about three volutions, gradually increasing in diameter; chambers distinct, four in each volution, sutures oblique and curved, slightly depressed, ventral side irregular, the last formed chamber occupying nearly one-half the area of the test, smoothly finished; aperture elongate, at the base of the chamber in the umbilical region, with a sort of lip-like projection above; color reddish or yellowish brown. Diameter, up to 0.45 mm.

He however omitted to select a type-specimen, which is unfortunate, for as will be seen three of the four individuals illustrated by Balkwill & Wright (and Cushman), though of similar size are morphologically distinct, belonging even to separate genera. As long as the species



Figs 1-8 *Deuterammina (Deuterammina) rotaliformis* (Heron-Allen & Earland). Figs 1-3, Lectotype (N.M.I. no. 1.1980), Umbilical, edge and oblique-umbilical views. Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 12b. Figs 4, 5 Paralectotype (N.M.I. no. 2.1980). Edge and spiral views. Figs 6-8, Paralectotype (N.M.I. no. 3.1980). Oblique-umbilical, oblique and spiral views. All from Killiney Bay, E. Ireland, 8-14 fathoms (15-25 m). Ex Wright collection (13-1921), labelled *Trochammina inflata* var., $\times 220$.

lacked a type-specimen, no clear morphological concept existed and hence subsequent workers interpreted *T. rotaliformis* differently, for instance Höglund (1947), Murray (1971), and Todd & Low (1981).

In order to stabilize the concept of *T. rotaliformis* Heron-Allen & Earland, its morphological features need to be determined on the basis of a lectotype. Then, and only then can this species be properly identified and used meaningfully in taxonomic and ecological work.

At first glance Cushman's description (1920: 77) of *T. rotaliformis* apparently refers to the slightly smaller specimen shown in Balkwill & Wright's drawings (1885, pl. 13, fig. 11b) by an umbilical view, because he mentions four chambers per whorl and that the final chamber occupies nearly half of the umbilical side. Other features of this description referring to the spiral side, the aperture and the smoothly finished surface, on the other hand, seem to be derived from the other three specimens shown in the original illustrations (pl. 13, figs 11a; 12a, b) which clearly are morphologically different from the first mentioned individual. Cushman apparently regarded, as did Balkwill & Wright, the four specimens as conspecific. The supposition is confirmed by the grouping of Balkwill & Wright's four figures in Cushman's pl. 16—as fig. 1 (putting erroneously together as belonging to the same form, their original figs 12a and b) and, as fig. 2 (doing the same for their figs 11a and b). Cushman's description is therefore a composite one.

Recently Balkwill & Wright's figured specimens have been found in the National Museum of Ireland (N.M.I.) preserved in the Joseph Wright Collection (13–1921) and in the light of the above confusion, it is opportune to select a lectotype and describe the species afresh. Of their figured material, those specimens representing pl. 13, figs 11b, 12a and 12b (1885) have been photographed using a Scanning Electron Microscope and are re-illustrated by our respective Figs 1–3, 25 (=fig. 12b); Figs 13–16, 26 (=fig. 12a) and Figs 17–20, 27 (=fig. 11b). The specimen shown in their fig. 11a has not been scanned; it has, we can confirm, the same umbilical features as that shown in fig. 12b.

Our micrographs clearly demonstrate that the original illustrated specimens were not conspecific, but in fact belong to three different species which are placed according to their apertural characteristics into the genera *Deuterammina* (*Deuterammina*) (Balkwill & Wright, 1885, pl. 13, figs 11a; 12a, b) and *Paratrochammina* (*Paratrochammina*) (figs 11b).

We designate Balkwill & Wright's specimen N.M.I. 1.1980, shown originally in umbilical view (fig. 12b) as lectotype of *D. (D.) rotaliformis* (Heron-Allen and Earland). Their fig. 11a is also conspecific and as it is by far the commonest form in the material labelled '*T. inflata* var.' or '*T. rotaliformis* MS' in the Wright Collection from E. Ireland, it would therefore seem the logical choice. The remaining two specimens from the original figured material are described as *D. (D.) balkwilli* (=fig. 12b) and *Paratrochammina (P.) wrightii* (=fig. 11b), while a further species has been isolated in Wright's faunal slide collection labelled as *T. rotaliformis*. Previously not illustrated, it has distinctive apertural characters and is described as *Deuterammina (Centrodeuterammina) dublinensis* subgen. et sp. nov.

Systematics

The specimens illustrated in this paper are deposited in the National Museum of Ireland, Dublin, and registered as 1.1980–3.1980 and 107.1981–111.1981, inclusively.

Genus *DEUTERAMMINA* Bronnimann, 1976, emended Brönnimann & Whittaker, 1983

Subgenus *DEUTERAMMINA* Brönnimann, 1976

TYPE-SPECIES. *Trochammina glabra* Heron-Allen & Earland, 1932.

Deuterammina (Deuterammina) rotaliformis (Heron-Allen & Earland)
(Figs 1–8, 25)

1885 *Trochammina inflata* (Montagu) var. Balkwill & Wright (*pars*): 331, pl. 13, figs 11a, 12b only.
1889 *Trochammina inflata* var. Balkwill & Wright (*sic*); Halkyard: 63, pl. 1, fig. 10.

1892 *Trochammina inflata* (Montagu) var. Balkwill & Wright; Chaster: 58.

1911 *Trochammina rotaliformis* J. Wright MS: Heron-Allen & Earland: 309 (availability of name).

1920 *Trochammina rotaliformis* J. Wright; Cushman (*pars*): 77, pl. 16, fig. 1 (right), 2 (left) only. [After Balkwill & Wright, 1885].

1973 *Trochammina astrifica* Rhumbler; Haynes (*pars*): 34, pl. 4, fig. 18 only (*non Trochammina squamata* Jones & Parker *astrifica* Rhumbler, 1938).

1974 *Trochammina rotaliformis* Wright; Lévy *et al.*: pl. 1, figs 4, 5.

MATERIAL. 9 syntypes, 3 from Killiney Bay, 6 from off Drogheda, E. Ireland. Wright Collection (13–1921), National Museum of Ireland (N.M.I.), Dublin.

LECTOTYPE. N.M.I. no. 1.1980, from slide labelled *Trochammina inflata* var., Killiney Bay, E Ireland, long. 6°8'W, lat. 53°15'N, depth 8–14 fathoms (15–25 m). Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 12b. Refigured in Figs 1–3, 25.

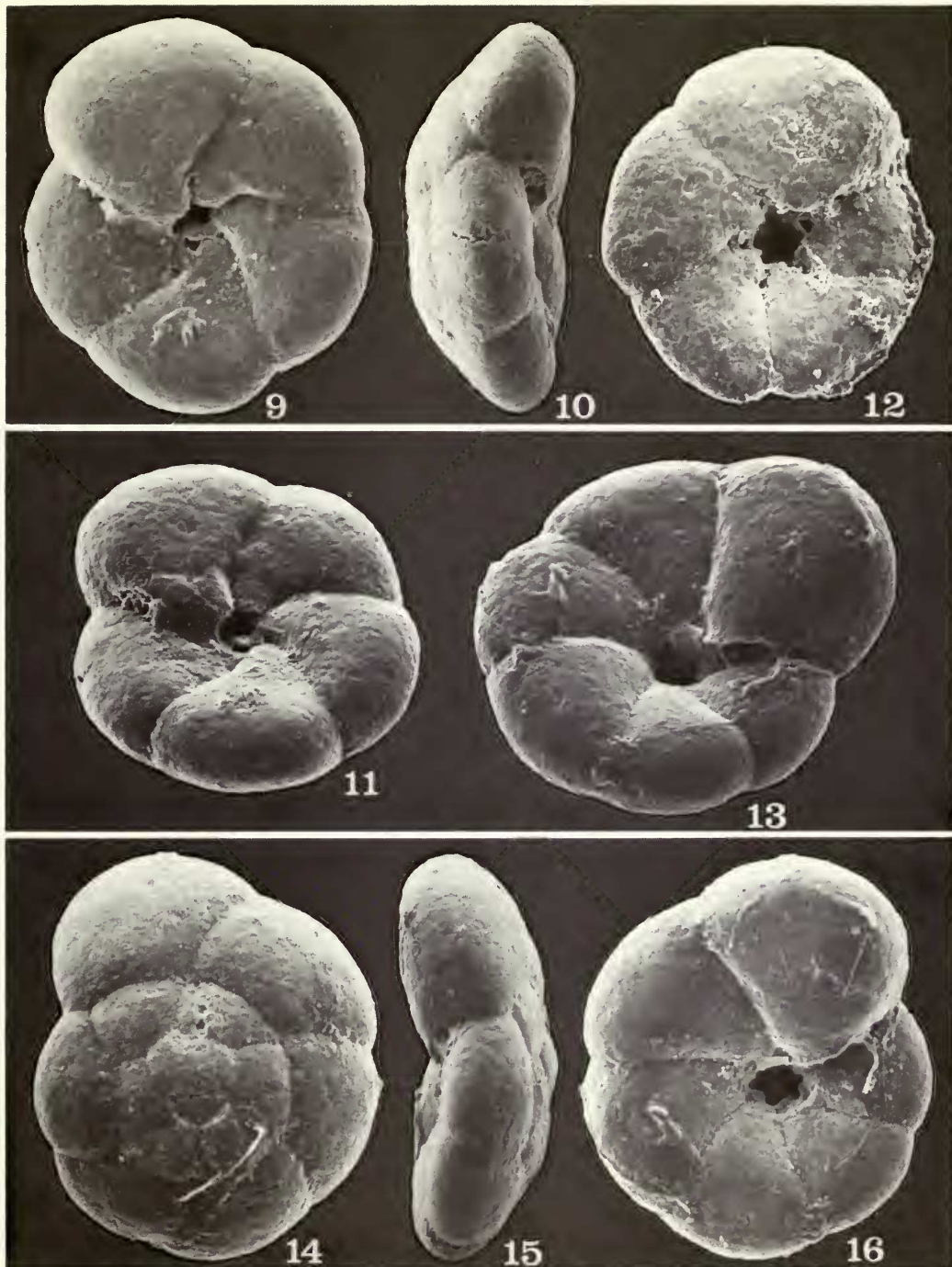
DESCRIPTION (LECTOTYPE). Test free, a low dextral trochospire, subcircular in umbilical and spiral views and slightly lobate. In edge view, broadly domed on the spiral side though somewhat flattened axially; shallow-concave umbilically; periphery sharply rounded, but not carinate. Umbilical depression star-shaped, open and deep with five branches. On spiral side, small subglobular proloculus followed by about 20 chambers arranged in at least three whorls with five chambers in the final whorl. Radial and spiral sutures not well defined in the early volutions and thus exact numbers of chambers difficult to determine. In final whorl, slightly curved intercameral sutures are but little depressed spirally; rather more so on umbilical side. Septum not infolded. Umbilically, shape of chamber broadly triangular; spirally, low and elongate. Two sets of apertures consisting of an interiomarginal extraumbilical primary opening of *Trochammina*-type and a secondary opening in a umbilical-sutural, posteriorly directed position. Secondary openings lead directly into the umbilicus and probably remain functional throughout ontogeny. Primary openings, on the other hand, not in direct connection with umbilical depression, only the last-formed connecting with the exterior. Final primary opening devoid of any lip-like structure but secondary openings accompanied by distinct extensions which normally are well separated from septal wall. Wall single-layered and imperforate. Agglutinant of quartz flakes arranged in mosaic-like pattern. Colour reddish brown.

DIMENSIONS (LECTOTYPE). Maximum spiral and umbilical diameter 260 µm, minimum diameter 230 µm; thickness (axial height) 100 µm. Maximum diameter of star-shaped umbilical depression 60 µm, length of each branch of star c.20 µm. Length and height of primary aperture, 27 and 9 µm respectively. Extension associated with secondary apertures (final chamber) 30 × 15 µm.

VARIATION (PARALECTOTYPES). 4 paralectotypes have been chosen from the remaining syntypic series, two each from Killiney Bay, and from off Drogheda, (long. 6°15'W, lat. 53°45'N), N.M.I. no. 2.1980, 3.1980, and 107.1981, 108.1981, respectively. Their overall morphology is similar to that of the lectotype, two are dextral, two, sinistrally coiled. All, together with the remaining unfigured specimens in the Wright Collection, are characterized by 5 chambers in the final whorl and by the same, 5-branched star shaped, open and deep umbilical depression, into which the secondary openings of the chambers of the final whorl lead under the hook-shaped lip-like extensions. Paralectotype 2.1980 (Figs 4, 5) is made up of about 20 chambers and a subglobular proloculus of about 10 µm diameter. The number of chambers of the spirally shown paralectotype (3.1980: Figs 6–8) cannot be determined, the early volutions being masked by foreign matter.

DIMENSIONS (PARALECTOTYPES)

N.M.I. no. (Fig.)	Diameter		Thickness (axial height)
	Maximum	Minimum	
2.1980 (Figs 4, 5)	240 µm	220 µm	100 µm
3.1980 (Figs 6–8)	220 µm	200 µm	—
107.1981 (Figs 9–11)	250 µm	220 µm	100 µm
108.1981 (Fig. 12)	230 µm	210 µm	—



Figs 9–12 *Deuteramma* (*Deuteramma*) *rotaliformis* (Heron-Allen & Earland). Figs 9–11, Paralectotype (N.M.I. no. 107.1981). Umbilical, edge and oblique-umbilical views. Fig. 12, Paralectotype (N.M.I. no. 108.1981). Umbilical view.

Both from off Drogheda, E. Ireland, 16 fathoms (30 m). Ex Wright collection (13–1921), faunal slide no. 34. $\times 220$.

Figs 13–16 *Deuteramma* (*Deuteramma*) *balkwilli* sp. nov. Holotype (N.M.I. no. 109.1981). Oblique-umbilical, spiral, edge and umbilical views. Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 12a.

From Killiney Bay, E. Ireland, 8–14 fathoms (15–25 m). Ex Wright collection (13–1921), labelled *Trochamma inflata* var., $\times 220$.

REMARKS. *D. (D.) rotaliformis* (Heron-Allen & Earland) has been compared with the deep-water deuteraminids found in the *Discovery* material from the S. Atlantic and Antarctic waters—*D. (D.) discorbis* (Earland), *D. (D.) glabra* (Heron-Allen & Earland), *D. (D.) grisea* (Earland) and other, so far undescribed species (Brönnimann & Whittaker, in preparation). It is easily distinguishable by its overall morphology, the position and shape of the primary aperture, plus the hook-shaped, lip-like extensions (see Fig. 25) under which the secondary openings occur.

D. (D.) rotaliformis under the name '*Trochammina rotaliformis* Wright' or 'Wright MS' is one of the most frequently cited taxons in the Trochamminidae, notwithstanding the fact that, lacking up till now a type specimen, no-one could have known its true morphology (Heron-Allen & Earland, 1916 : 228; 1922 : 114; 1932 : 344; Earland, 1933 : 85; 1934 : 99; Parr, 1950 : 276; Collins, 1958 : 354; and others). Furthermore in almost all cases where it has been illustrated (Heron-Allen & Earland, 1913 : 52, pl. 3, figs 11–13; Cushman & McCulloch, 1939 : 107, pl. 87, figs 2a–c; Cushman & Todd, 1947 : 7, pl. 1, fig. 14; Cushman, 1948 : 42, pl. 4, fig. 16; Todd & Low, 1967 : 418, pl. 1, figs 18a, b; 1981 : 18, fig. 49; Murray, 1971 : 39, pl. 12, figs 1–5; Van Voorthuysen, 1973 : pl. 13 (pl. 14 on plate explanation), figs 3a–c) it invariably does not correspond with the lectotype as selected in the present paper. Only two records subsequent to the original citation appear definitely conspecific; one is by Haynes (1973 : 34, pl. 4, fig. 18 (but not figs 19 and 20) who illustrated a specimen from Cardigan Bay, W. Wales (as *Trochammina astrifica* Rhumbler), which is typical of *D. (D.) rotaliformis*. The other is by Lévy *et al.* who illustrated (1974 : 128, pl. 1, figs 4, 5) from Dunkirk beach sand, N. France, an umbilical and spiral view, of the true *rotaliformis*. The umbilical view of their specimen, in particular, shows beautifully the double aperture.

***Deuterammina (Deuterammina) balkwilli* sp. nov.**

(Figs 13–16, 26)

1885 *Trochammina inflata* (Montagu) var. Balkwill & Wright (*pars*): 331, fig. 12a only.

1920 *Trochammina rotaliformis* J. Wright; Cushman (*pars*): 77, pl. 16, fig. 1 (left) only. [After Balkwill & Wright, 1885].

?1971 *Trochammina rotaliformis* Heron-Allen & Earland; Murray (*pars*): 39, pl. 12, fig. 5 only.

DIAGNOSIS. A 6-chambered, compressed *Deuterammina*. Star-shaped umbilical depression small with 6 very short radial branches. Primary and secondary apertures poorly separated.

NAME. For F. P. Balkwill, co-author with J. Wright of the paper 'Recent Foraminifera off the coast of Dublin and Irish Sea', 1885.

MATERIAL. 1 specimen, ex J. Wright Collection (13–1921), National Museum of Ireland (N.M.I.), Dublin.

HOLOTYPE. N.M.I. no. 109.1981, from slide labelled *Trochammina inflata* var., Killiney, E. Ireland, long. 6°8'W, lat. 53°15'N, depth 8–14 fathoms (15–25 m). Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 12a. Refigured in Figs 13–16, 26.

DESCRIPTION (HOLOTYPE). Test free; a low sinistral trochospire consisting of about 16 axially compressed chambers arranged in 3 whorls with 6 chambers in the final whorl. Suboval in umbilical and spiral views and slightly lobate. In edge view, gently convex spirally and shallow-concave umbilically; periphery rounded. Umbilically, shape of chambers roughly triangular separated by almost straight sutures; spirally, chambers are elongate and relatively low, separated by curved sutures. Radial and spiral sutures well defined. Umbilical depression open and deep, characterized by star-shaped outline with 6 short radial branches, the result of incomplete overlap of the apertural rim of the primary aperture on that of the preceding chamber. Two sets of apertures consisting of primary interiomarginal opening in umbilical-extraumbilical position and a minute posteriorly directed secondary opening in sutural position, hence of *Deuterammina*-type. Primary opening an elongate slit accompanied by an upturned rim, the prolongation of the septal wall. It rests with its border on the

first and penultimate chamber of final whorl (Figs 13, 26). Secondary openings not well-separated from large slit-like interiomarginal primary openings: however, recognizable as minute sutural slits between ends of apertural rims of primary openings and those of preceding chambers; they occur below proximal sides of radial branches and are posteriorly directed. All primary and secondary openings are in direct communication with the umbilical cavity and hence the exterior. Wall agglutinated, smooth, and apparently single-layered and imperforate. Surface appears finely granular on both sides, but granulation slightly coarser umbilically.

DIMENSIONS (HOLOTYPE). Maximum spiral and umbilical diameter 260 μm , minimum diameter 220 μm , thickness (axial height) 90 μm . Maximum diameter of star-shaped umbilical depression 40 μm , length of each branch of star c.10 μm . Length and height of primary aperture, 60 and 22 μm , respectively; width of apertural rim c.5 μm .

REMARKS. *D. (D.) balkwilli* differs from *D. (D.) rotaliformis* (Heron-Allen & Earland) essentially in the apertural features. In the latter, the primary and secondary openings are separated, the secondary sutural, posteriorly directed openings are much longer and better developed than in *D. (D.) balkwilli*. As the primary and secondary openings in our new species cannot be clearly separated, except by assuming that the extent of the apertural rim marks the extent of the primary aperture, there is some evidence for a new subgeneric deuteramminid taxon distinct from *Deuterammina* (*Deuterammina*) Brönnimann, 1976 and *D. (Lepidodeuterammina)* Brönnimann & Whittaker, 1983. However, this would be premature with the material available. *D. (D.) balkwilli* has 6 chambers in the final whorl as against 5 in *D. (D.) rotaliformis* and a slightly different aspect in edge view. Murray's photograph (1974, pl. 12, fig. 5) of a six-chambered specimen of what he calls *Trochammina rotaliformis* Heron-Allen & Earland could be conspecific with ours. It is however only shown in edge view, the spiral and umbilical views are of different specimens and a different species (see p. 357 below).

Genus *DEUTERAMMINA* Brönnimann, 1976

Subgenus *CENTRODEUTERAMMINA* subgen nov.

TYPE SPECIES. *Deuterammina (Centrodeuterammina) dublinensis* Brönnimann & Whittaker, 1983.

DEFINITION. Test free, trochospiral, low, but not 'watchglass' shaped. Wall agglutinated, single-layered, imperforate. Chambers axially compressed; without inner structures. Aperture double: primary opening interiomarginal, extraumbilical; secondary or supplementary opening at umbilical tip of chamber; directed centrally into umbilical cavity.

NAME. Subgeneric name refers to centrally directed secondary opening.

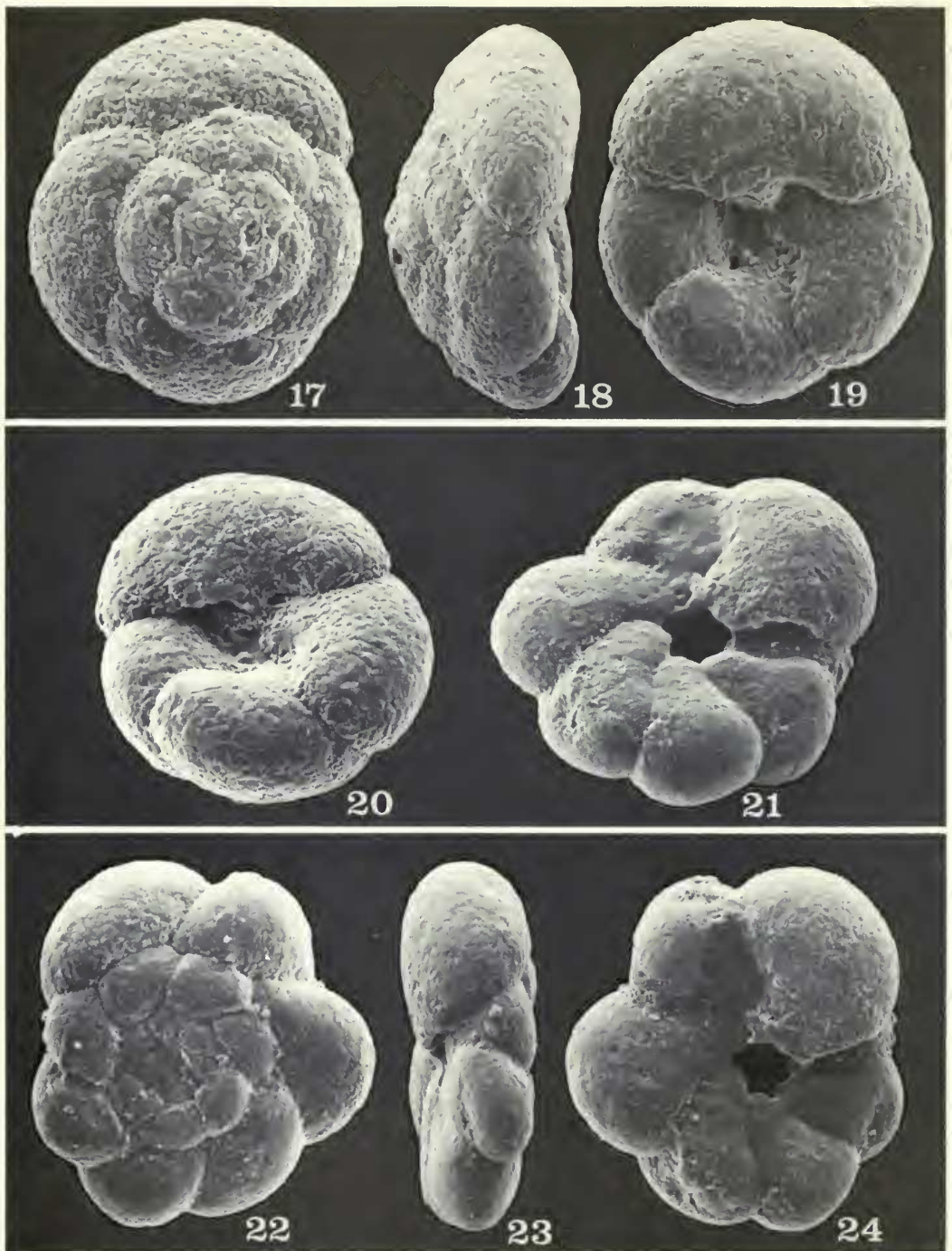
REMARKS. *D. (Centrodeuterammina)* differs from *D. (Deuterammina)* and *D. (Lepidodeuterammina)* (see Brönnimann & Whittaker, 1983), both of which possess secondary openings posteriorly directed in an umbilical-sutural position. The secondary openings of *D. (Centrodeuterammina)* are centrally directed and occur at the umbilical tip of the chambers. *D. (Lepidodeuterammina)* differs further from both *D. (Deuterammina)* and *D. (Centrodeuterammina)* by the attached, 'watchglass' shaped test.

Deuterammina (Centrodeuterammina) dublinensis sp. nov.

(Figs 21–24, 28–30)

DIAGNOSIS. A 7-chambered deuteramminid, compressed in edge view; spiral side plano-convex. Strongly lobate in umbilical/spiral views, chambers slightly inflated, spiral and radial sutures well defined. Umbilical depression narrow and deep.

NAME. After the type locality, Killiney Bay, near Dublin, Eire.



Figs 17–20 *Paratrochammina (Paratrochammina) wrighti* sp. nov. Holotype (N.M.I. no. 110.1981). Spiral, edge, umbilical and oblique-umbilical views. Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 11b. From off Drogheda, E. Ireland, 16 fathoms (30 m). Ex Wright collection (13–1921), labelled *Trochammina inflata* var., $\times 220$.

Figs 21–24 *Deuterammina (Centrodeuterammina) dublinensis* subgen. et sp. nov. Holotype (N.M.I. no. 111.1981). Oblique-umbilical, spiral, edge and umbilical views. From Killiney Bay, E. Ireland, 8–14 fathoms (15–25 m). Ex Wright collection (13–1921), faunal slide no. 27. $\times 220$.

MATERIAL. 1 specimen, ex Wright Collection (13-1921), National Museum of Ireland (N.M.I.), Dublin.

HOLOTYPE. N.M.I. no. 111.1981, from faunal slide no. 27, Killiney Bay, E. Ireland, long. 6°08' W, lat. 53°15' N, depth 8-14 fathoms (15-25 m). Specimen illustrated in Figs 21-24, 28-30.

DESCRIPTION (HOLOTYPE). Test free, trochospiral; coil very low, sinistral, consisting of 20 chambers, including the proloculus, arranged in three whorls with 7 chambers in the last whorl. Chambers of at least the last two whorls, axially compressed. Subcircular in umbilical and spiral views and strongly lobate. In edge view, spiral side almost plano-convex, umbilical side shallow-concave, periphery rounded. Radial and spiral sutures slightly curved, in early whorls straight-oblique; umbilically, slightly sinuous. Umbilical depression narrow, deep, showing at the sutures short sutural branches formed by the overlap of the rims of the secondary umbilically-directed openings on those of the preceding chamber. Each chamber with two apertures: a primary interiomarginal opening in an extraumbilical position of *Trochammina*-type (that is with its borders resting completely on the wall of the first chamber of the final whorl) and a secondary opening at umbilical tip of chamber, directed into axial cavity. Primary apertures covered by succeeding chambers leaving only ultimate one to communicate directly with exterior, whereas all secondary apertures open into umbilical depression and remain functional. Primary interiomarginal opening an elongate slit devoid of any border lip but edged with granules (Fig. 28). Secondary openings arranged in a low trochospire within umbilical cavity (Fig. 30): in the early part of the coil, short and semicircular; final ones, elongate with more or less flat walls. Borders of early openings a series of discrete granules and flakes arranged more or less perpendicularly to the borders, later ones have thin walls devoid of granules. Agglutinated wall apparently single-layered and imperforate. Spiral side with granules, umbilical side with flakes and granules, the latter surface of distinctly coarser texture.

DIMENSIONS (HOLOTYPE). Maximum diameter in umbilical and spiral view 240 µm, minimum diameter 220 µm, thickness (axial height) 80 µm. Maximum diameter of umbilical cavity 40 µm. Length and height of primary aperture, 55 and 10 µm, respectively; ditto, secondary apertures (early coil), 10 × 5 µm.

REMARKS. This species was not figured by Balkwill & Wright, 1885, but was contained in Wright's faunal slide collection and from his MS identification was clearly considered by him to fall within the concept of *T. rotaliformis*.

Genus **PARATROCHAMMINA** Brönnimann, 1979 emended Brönnimann & Whittaker

EMENDED GENERIC DEFINITION. Test trochospiral, free. Wall agglutinated, single layered, imperforate. Chambers devoid of inner structures (septal infoldings). Aperture single, interiomarginal, umbilical-extraumbilical; border of opening resting on umbilical wall of first chamber of last whorl and on that of penultimate chamber; asymmetric in respect to axis of coiling, with or without an umbilical flap.

TYPE SPECIES. *Paratrochammina madierae* Brönnimann, 1979. Recent. South Atlantic (Brazilian Shelf).

Subgenera of *Paratrochammina*

In the present classification of the Trochamminidae only the position of the single interiomarginal aperture is accepted as a generic criterion. Because the presence of an umbilical flap can be variably developed this character is here reduced to second order of importance and, unlike formerly (Brönnimann & Whittaker, 1981), now accepted only as of subgeneric significance. The genus is divided into *P. (Paratrochammina)* and *P. (Portatrochammina)*.

Subgenus *PARATROCHAMMINA* (*PARATROCHAMMINA*) Brönnimann, 1979

SUBGENERIC DEFINITION. Aperture single, interiomarginal, umbilical-extraumbilical, border of opening rests on umbilical wall of first chamber of last whorl and on that of penultimate chamber; asymmetric in respect to axis of coiling; without umbilical flap.

TYPE-SPECIES. As genus.

Subgenus *PARATROCHAMMINA* (*PORTATROCHAMMINA*) Echols, 1971

SUBGENERIC DEFINITION. Aperture single, interiomarginal, umbilical-extraumbilical, border of opening rests on umbilical wall of first chamber of last whorl and on that of penultimate chamber; asymmetric in respect to axis of coiling, with umbilical flap more or less covering umbilical depression.

Type-SPECIES. *Portatrochammina eltaninae* Echols, 1971 (= *Paratrochammina* (*Portatrochammina*) *antarctica antarctica* (Parr, 1950). Recent. Soctia Sea, Antarctica.

Paratrochammina (*Paratrochammina*) *wrighti* sp. nov.

(Figs 17–20, 27)

1885 *Trochammina inflata* Montagu var. Balkwill & Wright (*pars*): 331, pl. 13, fig. 11b only.

?1913 *Trochammina rotaliformis* J. Wright MS; Heron-Allen & Earland: 52, pl. 3, figs 11–13.

1920 *Trochammina rotaliformis* J. Wright; Cushman (*pars*): 77, pl. 16, fig. 2 (right) only. [After Balkwill & Wright, 1885].

?1971 *Trochammina rotaliformis* Heron-Allen & Earland; Murray (*pars*): 39, pl. 12, figs 1–4 only.

DIAGNOSIS. A 4-chambered paratrochamminid. In edge view, convex spirally, shallow-concave umbilically. Chambers 'broad bean' shaped, spiral and radial sutures well defined. Central umbilical depression shallow, aperture with small lip-like plate.

NAME. After Joseph Wright, co-author with F. P. Balkwill of the first and only comprehensive and illustrated account of the foraminifera of the western Irish Sea.

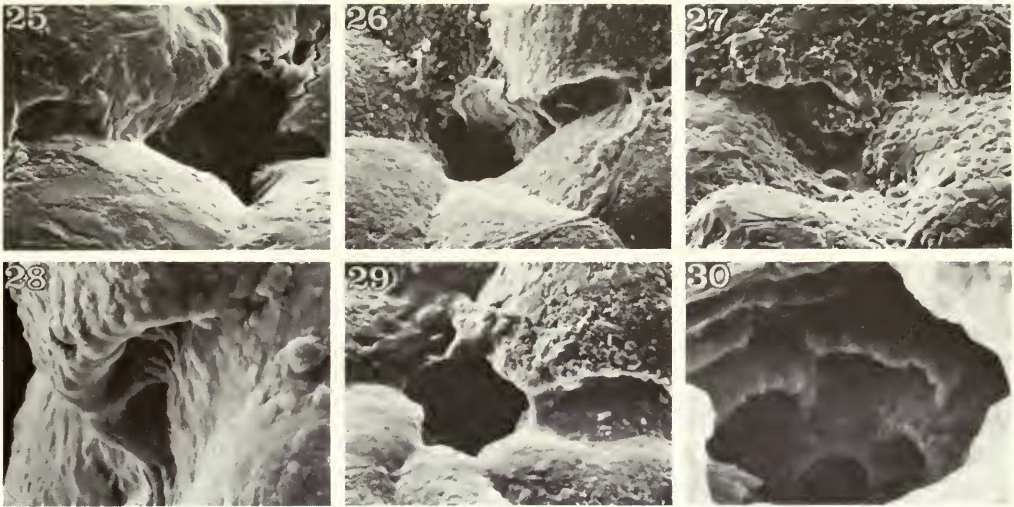
MATERIAL. 1 specimen, ex Wright Collection (13–1921), National Museum of Ireland (N.M.I.), Dublin.

HOLOTYPE. N.M.I. no. 110.1981, from slide labelled *Trochammina inflata* var., off Drogheda, E. Ireland, long. 6°15'W, lat. 53°45'N, depth 16 fathoms (30 m). Specimen figured by Balkwill & Wright, 1885, pl. 13, fig. 11b. Refigured in figs 17–20, 27.

DESCRIPTION (HOLOTYPE). Test free, trochospiral; coil moderately low, dextral, consisting of 13 chambers arranged in three whorls, with four chambers in final whorl and at least in last two whorls axially compressed. Broadly oval in umbilical and spiral views. In edge view, convex spirally, obtusely pointed axially; shallow-concave umbilically; periphery rounded. Chambers 'broad bean' shape umbilically, elongate crescentic spirally. Radial and spiral sutures well-defined. Intercameral sutures strongly curved spirally and somewhat sinuous umbilically. Umbilical depression, shallow, open. Single interiomarginal aperture of crescentic shape with central lip-like plate. Border of aperture rests on wall of first and third chamber of final whorl (of *P.* (*Paratrochammina*) type). Agglutinated wall appears single-layered and imperforate. Surface, fairly rough, composed of flakes and grains of rock fragments; texture of spiral surface coarser than umbilical.

DIMENSIONS (HOLOTYPE). Maximum spiral and umbilical diameter 250 µm, minimum diameter 220 µm, thickness (axial height) 120 µm. Maximum diameter of umbilical depression c.50 µm. Length of aperture 90 µm, length and width of apertural plate 50 and 9 µm, respectively.

REMARKS. The single *Paratrochammina*-type aperture readily distinguishes this species from the deuteramminids described above, all with double apertures. The central lip-like apertural



Figs 25–30 Apertural detail. Fig. 25, *Deuterammina (Deuterammina) rotaliformis* (Heron-Allen & Earland). Lectotype (N.M.I. no. 1.1980). Oblique view showing primary and secondary apertures, $\times 530$. Fig. 26, *Deuterammina (Deuterammina) balkwilli* sp. nov. Holotype (N.M.I. no. 109.1981). Oblique view showing primary and secondary apertures, $\times 360$. Fig. 27, *Paratrochammina (Paratrochammina) wrighti* sp. nov. Holotype (N.M.I. no. 110.1981). Oblique view of umbilicus and aperture, $\times 350$. Figs 28–30, *Deuterammina (Centrodeuterammina) dublinensis* sp. nov. Holotype (N.M.I. no. 111.1981). Fig. 28, edge view of primary aperture, $\times 950$. Fig. 29, oblique view of primary and secondary apertures, $\times 375$. Fig. 30, oblique close-up view of secondary apertures within open umbilicus, $\times 1000$.

plate does not cover the umbilical depression as it does in *Paratrochammina (Portatrochammina)*. Murray's 1971 illustrations (pl. 17, figs 1–4 only) of *T. rotaliformis* could belong to this form.

Acknowledgements

We are extremely grateful to Dr Colin Harris (Trinity College, Dublin) who first brought the whereabouts of the Joseph Wright Collection to our attention. The Director of the National Museum of Ireland kindly allowed us to borrow the material and gave permission for Scanning Electron Microscopy. Mr Mark Holmes, Natural History Division, N.M.I., facilitated the loan. Mr R. V. Melville, International Commission of Zoological Nomenclature, once again advised us on taxonomic procedure. Drs C. G. Adams and L. R. M. Cocks, British Museum (Natural History) commented helpfully on the text. The work of P. Brönnimann is in part funded by the Fonds National Suisse.

References

- Balkwill, F. P. & Wright, J. 1885. Report on some Recent foraminifera found off the coast of Dublin and in the Irish Sea. *Trans. R. Ir. Acad. (Sci.)* **28**: 317–372, pls 12–14.
- Brönnimann, P. & Whittaker, J. E. 1981. A redescription of *Trochammina nana* (Brady) (Protozoa: Foraminiferida), with observations on several other Recent Trochamminidae in the Collections of the British Museum (Natural History). *Bull. Br. Mus. nat. Hist. (Zool.)* **38**: 175–185, figs 1–34.
- & — 1983. *Deuterammina (Lepidodeuterammina)* subgen. nov., and a redescription of *Rotalina ochracea* Williamson (Protozoa: Foraminiferida). *Bull. Br. Mus. nat. Hist. (Zool.)* **45** (5): 233–238, figs 1–10.

- Chaster, G. W. 1892. Report upon the Foraminifera of the Southport Society of Natural Science District. *Rept. Southport Soc. nat Sci.*, **1** : 54–71, pl. 1.
- Collins, A. C. 1958. Foraminifera. *Scient. Rep. Gt. Barrier Reef Exped.* **6** : 335–437, pls 1–5.
- Cushman, J. A. 1920. The Foraminifera of the Atlantic Ocean. Part 2—Lituolidae. *Bull. U.S. natn. Mus.* **104** (2) : 1–111, pls 1–18.
- 1948. Arctic Foraminifera. *Spec. Publs Cushman Lab.* **23** : 1–79, pls 1–8.
- & McCulloch, I. 1939. A report on some arenaceous foraminifera. *Allan Hancock Pacif. Exped.* **6** (1) : 1–113, pls 1–12.
- & Todd, R. 1947. Foraminifera from the coast of Washington. *Spec. Publs Cushman Lab.* **21** : 1–23, pls 1–4.
- Earland, A. 1933. Foraminifera. Part 2. South Georgia. *'Discovery' Rep.* **7** : 27–138, pls 1–7.
- 1934. Foraminifera. Part 3. The Falklands sector of the Antarctic (excluding South Georgia). *'Discovery' Rep.* **10** : 1–208, pls 1–10.
- Ellis, B. & Messina, A. 1940 *et seq.* *Catalogue of Foraminifera*. American Museum of Natural History, New York.
- Halkyard, E. 1889. Recent foraminifera of Jersey. *Trans. a. Rep. Manchr micro. Soc.*, **1889** : 55–72, pls 1, 2.
- Haynes, J. R. 1973. Cardigan Bay Recent Foraminifera (Cruises of the R. V. *Antur*, 1962–1964). *Bull. Br. Mus. nat. Hist. (Zool.) Suppl.* **4** : 1–245, pls 1–33.
- Heron-Allen, E. & Earland, A. 1911. On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex. 7. Supplement (Addenda et Corrigenda). *Jl R. micros. Soc.* **1911** : 298–343, pls 9–13.
- 1913. The foraminifera of the Clare Island District, Co. Mayo, Ireland. [Clare Island Survey. Part 64, Foraminifera]. *Proc. R. Ir. Acad.* **31** : 1–188, pls 1–13.
- 1916. The foraminifera of the West of Scotland. Collected by Prof. W. A. Herdman, F.R.S., on the Cruise of the S. Y. *Runa*, July–Sept. 1913. Being a contribution to *'Spolia Runiana'*. *Trans. Linn. Soc. Lond.*, **11** : 197–299, pls 39–43.
- 1922. Protozoa. Part 2. Foraminifera. *Br. Antarct. 'Terra Nova' Exped. (Zool.)* **6** : 25–268, pls 1–8.
- 1932. Foraminifera. Part 1. The ice-free area of the Falkland Islands and adjacent seas. *'Discovery' Rep.* **4** : 291–460, pls 6–17.
- Höglund, H. 1947. Foraminifera in the Gullmar Fjord and Skagerak. *Zool. Bidr. Upps.* **26** : 1–328, pls 1–32.
- Lévy, A., Mathieu, R., Poignant, A., Rosset-Moulinier, M. & Rouvillois, A. 1974. Les représentants des Ammodiscacea, Lituolacea, Nodosariacea, Buliminacea (Foraminifères) dans les sables des plage de Dunkerque. Remarques sur les espèces signalées par O. Terquem. *Revue Micropaléont.*, **17** : 127–133, pls 1, 2.
- Murray, J. W. 1971. *An Atlas of British Recent Foraminiferids*. xiii+244pp. 96 pls. Heinemann Educ., London.
- Parr, W. J. 1950. Foraminifera. *Rep. B.A.N.Z. antarctic Res. Exped.*, (ser. B. Zool. & Bot.), **5** : 233–392, pls 3–15.
- Todd, R. & Low, D. 1967. Recent foraminifera from the Gulf of Alaska and southeastern Alaska. *Prof. Pap. U.S. geol. Surv.* **573-A** : 1–46, pls 1–5.
- 1981. Marine Flora and Fauna of the Northeast United States. Protozoa: Sarcodina: Benthic foraminifera. *N.O.O.A. Tech. Rep. N.M.F.S. CIRC.*, Seattle, Wash., **439** : 1–59.
- Voortuysen, J. H. van 1973. Foraminiferal ecology in the Ria de Arosa, Galicia, Spain. *Zool. Verh. Leiden*, **123** : 1–68, pls 1–14.